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ACTIVE OXIDES IN DEAD-BURNED MAGNESITES

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There is a general opinion that the hydration of dead-burned magnesite is caused by active MgO and CaO .

The activity of these oxides means their capacity for hydration during the aging of moistened magnesite. Obviously, the conception of activity in this case considers the hydrating portion of total MgO and CaO versus that portion of oxides which is incapable of ~~activity~~ hydration.

D. A. Kisin [1] determined active MgO and CaO by the saccharate method which is used for determination of CaO in lime. On treating a sample of lime with ten percent solution of cane sugar, CaO enters a solution and all other components remain in precipitated form [2, 3].

According to laboratory experiments conducted by D. A. Kisin [1], the hydration rate of magnesite, being determined by the value of loss upon heating, increases with prolongation of the aging period, while the content of active oxides decreases almost to zero. This is in disagreement with Kisin's statement that "the hydration rate decreases with the decrease of active components".

In contrast to cane sugar, glucose forms soluble compounds with magnesium oxide. In connection with this, the author made an attempt to apply a glucose method for evaluating the hydration ability of dead-burned magnesite, thus using a new approach to the evaluation of active oxides in magnesite.

Magnesium oxide, calcium oxide, three samples of industrial magnesite powder and two samples of magnesite roasted in the laboratory at 1500° were taken as materials for the experiments.

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Procedure

A sample of material was treated with ten percent solution of glucose, in the cold or boiling, after which the insoluble residue was filtered off, washed, ignited and weighed. CaO and MgO were determined gravimetrically in filtrate.

Solubility of Magnesium Oxide

1. A 0.2-g sample of magnesium oxide roasted at 1600° was treated in the cold with 50 ml of solution for one hour. On the average, about 1.5% of sample dissolves. The amount of MgO in solution increases with prolongation of the treatment period.

2. 4-5% of a similar sample dissolved during a one-hour treatment with solution at 60-80°. Subsequent one-hour treatments of the same sample extract approximately the same amount of MgO as during the first treatment.

3. Dissolving of magnesium oxide proceeds more intensively in case of treatment with a boiling solution of glucose. First treatment extracts approximately twice as much of MgO as subsequent treatments, as shown in Table 1.

Influence of the length of treatment on the solubility of magnesium oxide under other similar conditions is shown in Table 2.

Table 1. Results of Treating a 0.2-g MgO sample with 50 ml of

Boiling Ten Percent Solution of Glucose

No of Treatments	1	2	3	4
Length of Treatments, hours	1	1	1	1
Solubility of MgO, %	23.3	9.6	10.6	8.2

Table 2. Influence of Treatment Time on Solubility of

Magnesium Oxide

Length of Treatments, hours	0.5	1	2	3
Solubility of MgO, %	19.0	22.9	35.6	46.0

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Tables 1 and 2 demonstrate that approximately the same quantity of MgO was dissolved during similar total periods regardless whether treatment was conducted successively with new portions of glucose (Table 1) or whether merely the time of treatment was increased (Table 2).

Table 3 illustrates the influence of the solvent volume. Tables 2 and 3 show that one-hour treatment with double volume of solution (100 ml) extracts almost the same amount of MgO as does two-hour treatment with a single volume of solution.

Table 3. Influence of the Volume of Solvent on
the Solubility of Magnesium Oxide

No of Samples	Volume of 10% Boiling Solu- tion of Glu- cose, ml	Amount of MgO dissolved dur- ing one hour, %
<u>No of Samples</u>	<u>cose, ml</u>	<u>%</u>
1	25	17.1
2	50	22.1
3	100	31.2

Table 4 presents data on the solubility of magnesium oxide with respect to the ^qtemperature at which it is roasted.

Table 4. Solubility of Magnesium Oxide with Respect to
the Temperature at which it is Roasted

Temperature of Roasting MgO	Solubility of MgO, %	Loss Upon Igniting Moist- ened Magnesium Oxide after 72 hour Aging and Subse- quent Drying at 100°, %
<u> </u>	<u> </u>	<u> </u>
1000°	12.7	28.8
1300°	20.5	21.8
1600°	24.5	3.2

It may be seen from Table 4 that the solubility of magnesium oxide increases with increase of roasting temperature, whereas its capacity for hydration decreases.

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Solubility of Calcium Oxide

Regardless of roasting temperature, calcium oxide dissolves completely during 10-20 minutes of treatment with glucose solution, in the cold or boiling.

According to above data, it is quite impossible to separate an active or easily soluble portion of magnesium oxide which would permit evaluation of the hydration ability of the initial sample of magnesium oxide. The same conclusion can be made in regard to calcium oxide which is entirely soluble. The sample of magnesium oxide roasted to 1600° happened to have the highest solubility; however, its hydration ability is considerably lower than that of samples roasted to 1000° and 1300°.

Solubility of Magnesites of Industrial and Laboratory Roastings

The solubility of magnesite is considerably lower than that of magnesium oxide. Therefore, 0.5-g samples were taken in this case and glucose solution was used in the amount of 125 ml for treatment, while boiling, for one hour.. Losses upon ignition of the initial samples of magnesite were determined after long aging in moistened state and drying at 100°.

Table 5. Chemical Composition of the Samples of
Roasted Magnesite (%)

<u>Samples of</u> <u>Magnesite</u>	<u>SiO₂</u>	<u>TiO₂</u>	<u>Al₂O₃</u>	<u>Fe₂O₃</u>	<u>CaO</u>	<u>MgO</u>	<u>Loss on</u> <u>Ignition</u>	<u>Remarks</u>
a. Industrial								
Furnace Magnesite I	2.73		3.26		4.13	89.60	0.28	
Furnace Magnesite II	4.00	0.07	11.79	2.14	3.60	87.33	0.26	
Shaft Magnesite	2.40	Trace	0.86	1.80	1.73	92.90	0.24	
b. Roasted in Lab								
No 1	0.33		0.08	1.07	1.03	97.89		Recalculated from analyses of raw magnesite
No 2	0.49		0.23	1.65	1.72	95.91		

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Table 6. Results of Treating the Samples of
Roasted Magnesite with 10% Solution of Glucose

Samples of Magnesite	Insoluble Residue (%)	Determined in filtrate, (%)			Total %	Length of Aging, Hours	Loss on Igni- tion (%)
		R_2O_3	CaO	MgO			
Furnace I	94.10	Trace	4.00	1.82	99.92	72	2.65
Furnace II	94.72	None	3.49	1.79	100.00	72	3.39
Shaft	95.26	None	1.70	3.06	100.02	72	3.54
No 1 Roasted to 1500°	93.92	Trace	1.16	4.74	99.88	288	2.82
No 2 Roasted to 1500°	95.80	Trace	1.32	3.07	100.15	288	2.40

Sesquioxides are not extracted from roasted magnesite with solution of glucose, as may be seen in Table 6. Calcium oxide was dissolved completely in four cases and to four fifths of its amount in one case. Magnesium oxide dissolved in the amount of 2-5%. Total solubility of all samples is approximately the same and does not exceed 5-6%. Consideration of losses on ignition in respect to solubility in ten percent solution of glucose does not permit the establishment of any definite relation between these indexes.

Conclusions

1. A saccharate method for determination of the active oxides of calcium and magnesium is not sufficiently substituted.
2. An attempt at using a glucose method for determination of active oxides demonstrated that certain regularities, observed in the process of dissolving CaO and MgO in glucose solution, can not be utilized for evaluating the hydration ability of roasted magnesite and ignited magnesium oxide.

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3. Results of this work and data obtained by D. A. Kisin permit to a conclusion that the conception of active oxides in dead-burned magnesite has no concrete meaning, since separation of one portion of the total amount of oxides from the other portion is impossible in the process of magnesite hydration.

One of the previous works conducted in the author's laboratory [4] proved that the extent of hydration (loss on ignition) of dead-burned magnesite continuously increases during aging.

The more intensive hydration process at the beginning of aging compared to the following periods can not be explained by the presence of active oxides with high hydration ability. Rather, less intensive hydration toward the end of aging is due to a protective action of magnesium hydroxide which envelops the grains of magnesium oxide.

Bibliography

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4. A. N. Yasinovskiy and V. V. Goncharov, "Ogneupory" (Refractories), 1946, No 4-5.

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